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Memorandum

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To: MR. KEVIN ROSS
Division of Structure Design
Office of Bridge Design South, Branch 12

Attention: Dan Texler

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Gonzales Creek Bridges
Bridge No. 57-1078 R/L

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services - MS 5
Office of Geotechnical Design - South

Subject Foundation Recommendations

This report presents the foundation recommendations for the proposed Gonzales Creek Bridges (Bridge No. 57-1078 R/L). The Structure Foundations South Branch (SFSB) of the Office of Geotechnical Design - South completed a foundation investigation pursuant to the July 24, 2000 request by the Office of Structure Design (OSD) for a foundation investigation and recommendations for the two proposed structures.

The following foundation recommendations are based on the subsurface information gathered during a recent foundation investigation (August 2000) performed by Caltrans along with a review of the subsurface information used to develop the Draft Type Selection Report. The Draft Type Selection Report (dated January 22, 1999) for the proposed structures was prepared by Boyle Engineering Corporation (BEC). With regards to the current foundation recommendations, all elevations referenced within this report and shown on the Log of Test Boring Sheets are based on the NAVD 88 vertical datum.

Project and Site Description

Each of these proposed structures is to consist of a three-span, cast-in-place, post-stressed concrete box girder bridge. The proposed bridge lengths and widths are 88.34 m and 12.77 m for the Left Bridge Structure and 94.29 m and 12.77 m for the Right Bridge Structure, respectively.

The project site is located just within the Carmel Valley area within San Diego County. The project site is located approximately 1.8 km east of the intersection of Carmel Country Road and State Route 56. The proposed Gonzales Creek Bridges are located along the proposed Route 56, where the proposed highway crosses Gonzales Creek. The proposed bridge sites will span Gonzales Creek, which is a subsurface, alluvial drainage that flows to the south. The land surrounding the proposed structure site is presently undeveloped and used for agricultural purposes

Geology

The subsurface investigation (August 2000) completed by Caltrans consisted of six mud rotary borings, which utilized a combination of (152mm diameter) hollow-stem auger and (114mm diameter) wireline-diamond coring (mud rotary) drilling methods. These mud rotary borings were advanced to a maximum depth of 33.6 m (110.2 ft) along with eight supplemental 64-mm diameter dynamic-displacement (hydraulically driven) soil soundings that were advanced to a maximum depth of 11.3 m (37.2 ft). Two supplemental 25mm diameter dynamic-displacement (wacker) borings were also performed.

The Caltrans subsurface investigation (August 2000) for the proposed Gonzales Creek Bridges (Bridge No. 57-1078 R/L) revealed that the soils encountered at the proposed bridge sites can be generally separated into two units.

On the hillside areas near the proposed Abutment 1, Bent 2 and Abutment 4 locations for the Left and Right Bridges, the upper unit soils are described as layers of (variably loose to medium dense) cultivated top soil consisting of silty sand, clayey sand, and sandy clay to depths ranging from 0.91 m (elev. 46.0 m; Boring B-00-2) to 1.62 m (elev. 43.9 m; Boring B-00-3). At the Bent 2, Right Bridge location (Boring B-8-01), construction of earth pads for drill rig access resulted in removal of approximately 1.0 m of the upper unit soil and exposed lower unit earth materials described below.

On the lower basin/creek area at the Bent 3 location, the upper unit soils are described as layers of (variably loose to medium dense) cultivated top soil and alluvial sediments consisting of silty sand, clayey sand, sandy silt and clay to depths ranging from of 7.62 m (elev. 37.0 m; Boring B-00-7) to 8.53 m (elev. 35.4 m; Boring B-00-6).

The upper unit soils at the site are underlain by a poorly indurated, non-cemented sandstone (La Jolla Group) consisting of a very dense, silty and clayey sand with silt, clay, gravel, and (hard) cobbles. Some localized hard lenses of well-cemented sandstone were encountered in the drilled borings, please see the Log of Test Boring Sheets for details. Of the six drilled borings, Boring B-00-6 (Bent 3, Right Bridge) was drilled with 152 mm diameter, hollow-flight augers to a depth of 16.82 m until drilling became too difficult to effectively advance the hole through formational earth materials, so diamond coring methods were used to advance the hole to a maximum depth of 33.6 m (elev. 10.32m).

The subsurface exploration completed by BEC, revealed similar soil conditions as described above with minor differences. For details of both the BEC and Caltrans subsurface investigation, please refer to the Log of Test Boring sheets.

During the BEC subsurface investigation, groundwater was encountered at elevation 31.5 m during augering of boring HSA-3. During the Caltrans subsurface investigation (August 2000), temporary slotted PVC casing placed inside Boring B-00-6 (Bent 3, Br. No 57-1078R) to measure groundwater. From August 2000 to January 2001, periodic groundwater measurements were recorded and varied from elevation 33.9 m to 33.2 m.

The proposed bridge site spans an existing natural drainage feature, therefore, during construction of the support bents the contractor should anticipate encountering groundwater. Groundwater elevations will vary based on seasonal precipitation.

Scour

In a memorandum dated July 23, 2001, the Office of Structures Maintenance and Investigations (OSMI) performed a hydraulic study for the proposed bridges. Their study found that the anticipated maximum local pier scour for the proposed bridges is approximately at the same level as the existing thalweg elevation of the creek. The reference thalweg elevation used to determine local pier scour for both bridge sites was elevation 42.7 m. For details regarding the above mentioned recommendations, please contact Neal Ali at 916-227-0442 or Bill Lindsey at 916-227-9369.

Corrosion

Samples retrieved from the August 2000 foundation investigation (Boring B-00-2) were combined to make composite samples of earth materials at intervals from 0 to 2.0m depth, 2.0 to 4.6m depth and 11.0 to 12.2m depth. The Office of Testing and Technology Services, Corrosive Technology Branch (CTB) tested the three composite samples for corrosive potential. The results of the laboratory tests determined that two of the three composite samples were corrosive. Refer to Table 1 below for specific test results.

Table 1: Corrosion Test Summary-Composite Samples

Boring Number/ Corrosion Number	Sample Depth (m)	pH	Minimum Resistivity (Ohm-Cm)	Sulfate Content (PPM)*	Chloride Content (PPM)*	Years To Perforation 18 ga. Galv. Steel Culvert
B-00-2 / 00-0756	0 to 2.0	7.2	850	134	58	N/A
B-00-2 / 00-0757	2.0 to 4.6	6.4	210	177	1460	N/A
B-00-2 / 00-0758	11.0 to 12.2	7.9	1100	N/A	N/A	N/A

*The Corrosion Technology Branch policy states that if the minimum resistivity is greater than 1000ohm-cm the sample is considered to be non-corrosive and testing to determine sulfate and chloride contents are not performed.

For site specific corrosion recommendations, refer to the memorandum regarding the corrosion review for this site, dated May 15, 2001, by Mr. Douglas Parks (916-227-7007) of the Corrosion Technology Branch.

Fault and Seismic Data

The site is potentially subject to strong ground motions from nearby earthquake sources during the design life of the new structure. The Newport-Inglewood-Rose Canyon (Strike Slip) fault, located approximately 9.7 km southwest of the site, is the controlling fault for this site with a maximum credible earthquake of Mw=7.0. The Peak Bedrock Acceleration at this site, based on

the Caltrans California Seismic Hazard Map, is estimated to be 0.4g. At this site, the liquefaction potential is considered very low.

For site specific seismic data and design recommendations, refer to the memorandum concerning final seismic design recommendations, dated May 8, 2001, by Mr. Jinxing Zha of the Office of Geotechnical Earthquake Engineering (OGEE).

Foundation Recommendations

The following recommendations are for the proposed Gonzales Creek Bridges (Bridge No. 57-1078 R/L), as shown on the General Plan provided by OSD and dated April 27, 2001. A combination of shallow and deep foundations is recommended for support of both the proposed Gonzales Creek Bridges.

Shallow Foundations

Spread footings are recommended for support at the Abutment 1, Bent 2 and Abutment 3 locations for both proposed structures. It is anticipated that both the Right and Left Bridge Abutment No. 4 and the Right Bridge Abutment No. 1 footings will be located on engineered fill constructed for the roadway approach to the bridge structures. However, the Left Bridge Abutment No. 1 bottom of footing elevation is partially situated on the top of the formational earth materials (La Jolla Group) described earlier. To eliminate the potential for differential settlement to occur across the Left Bridge Abutment No. 1 support location, sub-excavation of formational earth materials and replacement with engineered fill compacted to 95% relative compaction is recommended.

At the Bent 2 locations for both the Left and Right Bridges, spread footings may be used for support. The bottom of spread footing foundations shall be located on undisturbed, formational earth materials, as described earlier in the geology section. All footings should be constructed at or below the maximum estimated depth of scour or outside and above the potential scour zone. The recommended Gross Allowable and Ultimate Soil Bearing Pressures to be used for design are listed below in Table 2.

Table 2: Spread Footing Data
Gonzales Creek Left and Right Bridges (Br. No. 57-1078 R/L)

Support Location	Minimum Footing Width (m)	Bottom of Footing Elevation (m)	Recommended Soil Bearing Pressures	
			ASD[1]	LFD[2]
			Gross Allowable Soil Bearing Pressure (q_{all})	Ultimate Soil Bearing Pressure (q_{ult}*)
Abutment 1 (Left Bridge)	3.6	52.3	192 kPa (4.0 ksf)	N/A
Bent 2 (Left Bridge)	6.0	41.7	N/A	718 kPa (15.0 ksf)
Abutment 4 (Left Bridge)	3.6	51.45	192 kPa (4.0 ksf)	N/A
Abutment 1 (Right Bridge)	3.6	52.37	192 kPa (4.0 ksf)	N/A
Bent 2 (Right Bridge)	6.0	41.7	N/A	718 kPa (15.0 ksf)
Abutment 4 (Right Bridge)	3.6	51.45	192 kPa (4.0 ksf)	N/A

Notes: 1) Allowable Stress Design, (ASD). The Maximum Contact Pressure, (q_{max}), is not to exceed the recommended Gross Allowable Soil Bearing Pressure, (q_{all}). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed 3 times the recommended Gross Allowable Soil Bearing Pressure, (q_{all}).
2) Load Factor Design, (LFD). The Maximum Contact Pressure, (q_{max}), divided by the Strength Reduction Factor, (ϕ), is not to exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*).

The recommended gross allowable soil bearing pressures to be used for design, listed above in Table 2, are based upon the following design criteria:

(1) All footings shall have a minimum footing width of 3.6 meters for the abutments and a footing width of 6.0 meters for the Bent 3 locations.
(2) All abutment footings are positioned such that there will be a minimum horizontal distance of 1.22 meters from the near face/top of the footing to the face of the finished slope (Bridge Design Specifications 4.4.2.1).
(3) All concrete at the Bent 2 footing locations, shall be placed neat against the undisturbed formational materials at the bottom of footing excavation.
(4) At the Left Bridge (Br. No. 57-1078L), Abutment No. 1, the footing shall be supported on 0.61 meter of engineered fill (extending down to elevation 51.69 meters) compacted to 95% relative compaction. The limits of sub-excavation and replacement with structure backfill shall conform to the limits required for relative compaction under retaining wall footings without piles as defined in section 19-5.03 of the Standard Specifications.

If any of the above minimum footing widths, horizontal embedment depth or sub-excavation limits are reduced, the SFSB is to be contacted for reevaluation.

Deep Foundations

At the Bent 3 locations for both the Left and the Right Bridges, driven Class 625C , Alternative V closed-end, steel pipe piles are recommended for support. The Specified Tip Elevation (SPTE) is listed below in Table 3. The ultimate geotechnical capacity of the piles will equal or exceed the required nominal resistance in compression shown in the table below.

Table 3: Pile Data: Class 625, Alternative V Steel Pipe Piles (Closed Ended)

Location	Pile Type	Design Load	Nominal Resistance		Design Tip Elevation (m)	Specified Tip Elevation (m)
			Compression	Tension		
Bent 3 Left Bridge	Class 625C, Alt V	475 kN	950 kN	0 kN	35.0 (1)	35.0
Bent 3 Right Bridge	Class 625C, Alt V	500 kN	1000 kN	0 kN	31.0 (1)	31.0

Design tip elevation is controlled by the following demands: (1) Compression.

General Notes

1. The structure engineer shall show on the plans, in the pile data table, the minimum pile tip elevation required to meet the lateral load demands. If the specified pile tip elevation required to meet lateral load demands exceed the specified pile tip elevation given within this report, the Office of Geotechnical Design - South, Structure Foundations South should be contacted for further recommendations.

2. Support locations are to be plotted on the Log of Test Borings, in plan view, as stated in "Memos to Designers" 4-2. The plotting of the support locations should be made prior to the foundation review.

Construction Considerations

1. Due to granular nature of the soils, primary settlement is expected to occur immediately and concurrent with fill placement; therefore, no waiting period is required prior to beginning construction of the abutment spread footings.

2. Concrete for all abutment footings shall be placed neat against the undisturbed engineered fill at the bottom of the footing excavation. Should the bottom of the footing excavation be disturbed at the abutments, then the disturbed soils shall be recompacted to 95% relative compaction prior to placement of concrete for the structure support footings.

3. Concrete for all Bent 2 footing locations shall be placed neat against the undisturbed formational materials at the bottom of footing excavation. Should the bottom of the footing excavation be disturbed, then the bottom of footing excavation shall be extended

down at 0.30 meter intervals until undisturbed formational materials are observed and approved by the Engineer.

4. Difficult drilling and pile installation should be anticipated due to the presence of very dense formational earth materials (La Jolla Group) with cobbles and localized lenses of well-cemented sandstone underlying the proposed bridge sites (see Log of Test Boring Sheets for details). Driven pre-cast concrete piles are not recommended; steel piles are recommended.

5. At the Bent 3 locations for both structures, the calculated geotechnical capacity of all driven piles is based upon End Bearing only. All driven piles are to achieve the required bearing during driving.

6. Pile bearing will be accessed by the ENR equation (Standard Specifications in Section 49-1.08).

7. Prior to driving each pile, drilling to assist driving (Standard Specifications in Section 49-1.05) will be required to obtain the specified penetration. Any drilling to assist driving, shall not extend beyond the recommended depth stated in Table 4. Equipment or methods used for advancing holes shall not cause quick soil conditions or cause scouring or caving of the hole.

Table 4: Drilling to Assist Elevation

Location	Drilling to Assist Elevation (m)
Bent 3 On Ramp Bridge (Br. No. 57-1078L)	36.5 m
Bent 3 Right Bridge (Br. No. 57-1078R)	32.5 m

8. Any driven steel piles achieving refusal during driving within 1.3 meter of specified pile tip elevations may be considered good and cut off with the Engineer s written approval. Refusal shall be defined as a pile achieving two times (2x) the required design loading as shown on the contract plans and above in Table 3. Two times (2x) required design loading shall be 950 kN (107 tons) for Bent 3, Left Bridge and 1000 kN (112 tons) for Bent 3, Right Bridge.

The recommendations contained in this report are based on specific project information regarding structure type and structure location that has been provided by the Office of Structure Design. Any questions regarding the above recommendations should be directed to the attention of Hector Valencia (916) 227-7081 (CALNET 498-7081) or Mark DeSalvatore (916) 227-7056 (CALNET 498-7056), Office of Geotechnical Design - South, Structure Foundations South Branch.

Report by: Date: 8-6-01

Hector Valencia
Associate Engineering Geologist
Office of Geotechnical Design - South
Structure Foundations - South

Supervised by: Date: 8/6/01

Mark DeSalvatore, R.C.E., No. 039499
Senior Materials and Research Engineer
Office of Geotechnical Design - South
Structure Foundations - South

c: R.E. Pend. File — Struc Const
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